THE WASHINGTON, D. C. STORM OF JUNE 26, 1954

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INTRODUCTION

A pressure jump line passed Washington, D. C. about 1645 EST, June 26, 1954. The pressure jumps recorded on accelerated microbarographs at several locations in the city were among the largest ever recorded in the Middle Atlantic coastal area. Along the pressure jump line was a band of thunderstorms accompanied by strong winds, heavy rain, and severe lightning. Hail was reported in Baltimore, Md. The band of thunderstorms and pressure jumps had apparently moved from northwest of Chicago, Ill. early in the morning of June 26 to the Atlantic coast by evening of that day.

Because of the magnitude of the pressure jump recorded in Washington, and the severe weather that characterized it both on the Atlantic seaboard and in the vicinity of Chicago, a study was made to document this pressure jump line and give some additional meteorological features associated with it.

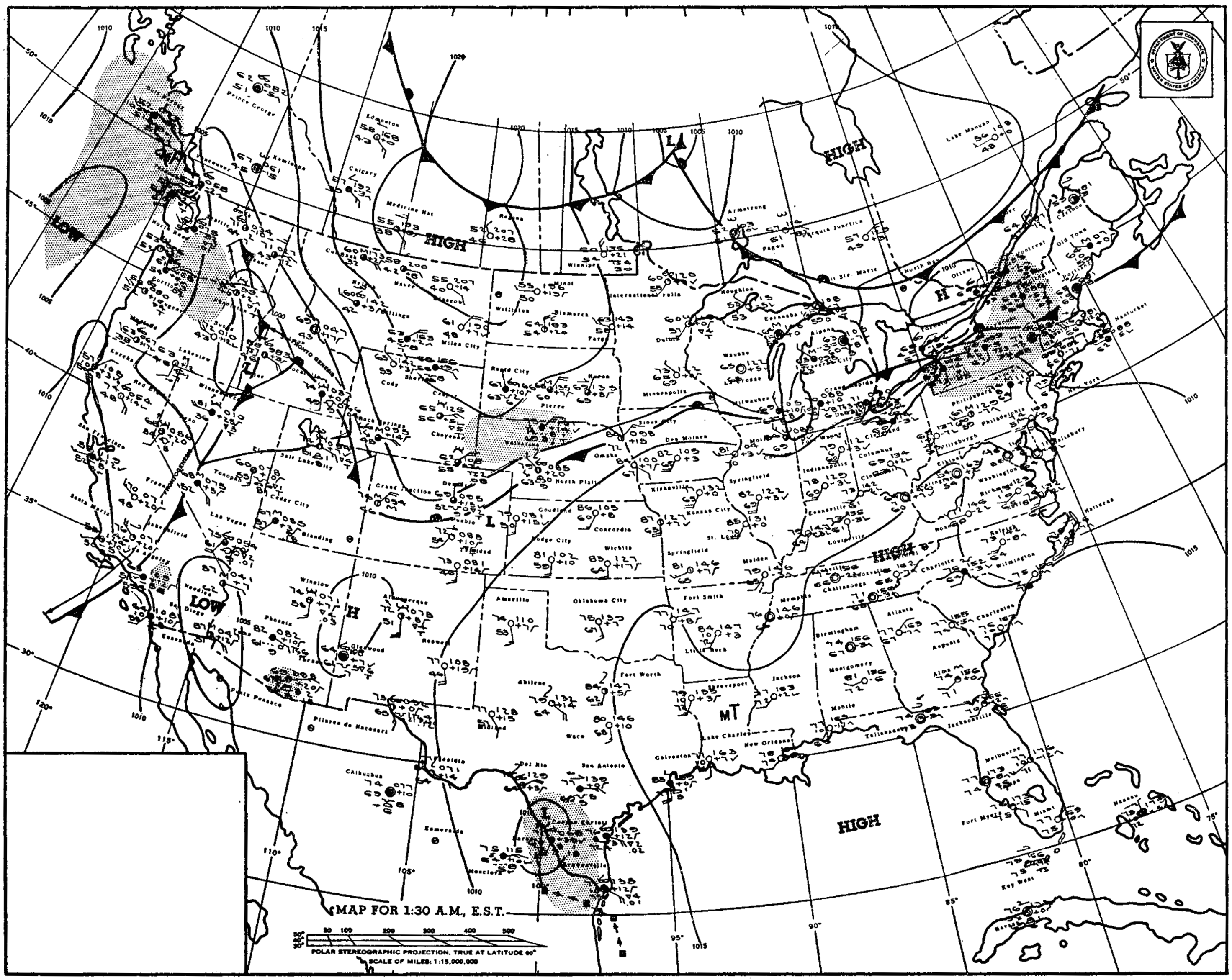

Figure 1.—Surface chart 0130 EST, June 26, 1954. Copy of *Daily Weather Map.*

SYNOPTIC SITUATION

The WBAN Analysis Center map for 0130 EST, June 26 showed a stationary front from central Colorado east-northeast to just south of Milwaukee, Wis., through New York, and across Vermont and New Hampshire (fig. 1). A cold front stretched across southern Canada about 150 miles north of North Dakota. There was little difference in frontal positions 12 hours later, except that the cold front from Canada was well into Wisconsin and Minnesota. By 1930 EST, there was a wave on the front (now analyzed as a cold front) in northern New York. The cold front extended from the wave through central Ohio and across Indiana and Illinois. The cold front from Canada had moved to southern Wisconsin and central Michigan. A squall line was indicated just off the coast from Virginia northward to New York.

The 700-mb. chart for 1030 EST (fig. 2) indicated a High centered over Tennessee and Mississippi with a ridge extending northwestward across the Great Plains into Montana and northwestern Canada. There was a deep trough just off the west coast and one somewhat less intense off the east coast. Upper winds from the Great Lakes to the Middle Atlantic coast were from the northwest. From 700 mb. to 500 mb., the winds were 30 to 40 knots. At 850 mb., the stationary front across the Great Lakes was located approximately 75 miles north of the surface position.

PRESSURE JUMP ANALYSIS

A series of pressure jumps began near Rochester, Minn., and La Crosse, Wis., during the early morning hours (0200 EST) of June 26 and moved through the surface position of the stationary front near Chicago. They were reported along a narrow band east-southeastward to the Virginia and Maryland coasts as shown in figure 3. The pressure jump line that traversed Washington, D. C., can be traced with certainty as far west as Front Royal, Va., and Martinsburg, W. Va. The pressure jump line which originated in Wisconsin and Minnesota and which was associated with the seiche in southern Lake Michigan, can be traced as far east as Morgantown, W. Va., and Blairsville, Pa. From considerations of continuity it seems reasonable to assume that the eastern pressure jump line was a continuation of the western one. No attempt has been made to investigate the relation to the seiche.

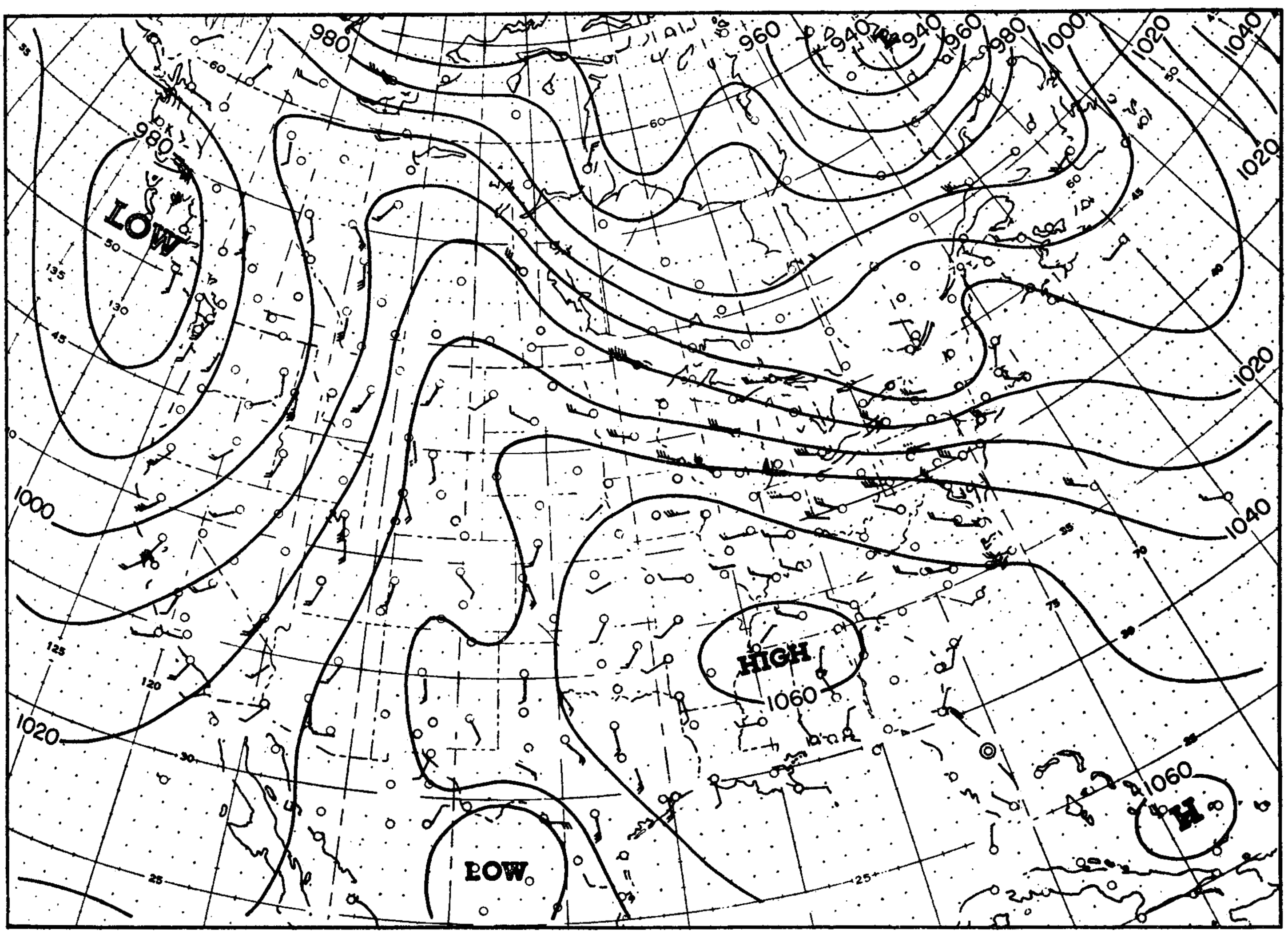

Figure 2.—700-mb. chart 1500 GMT (1000 EST), June 26, 1954.

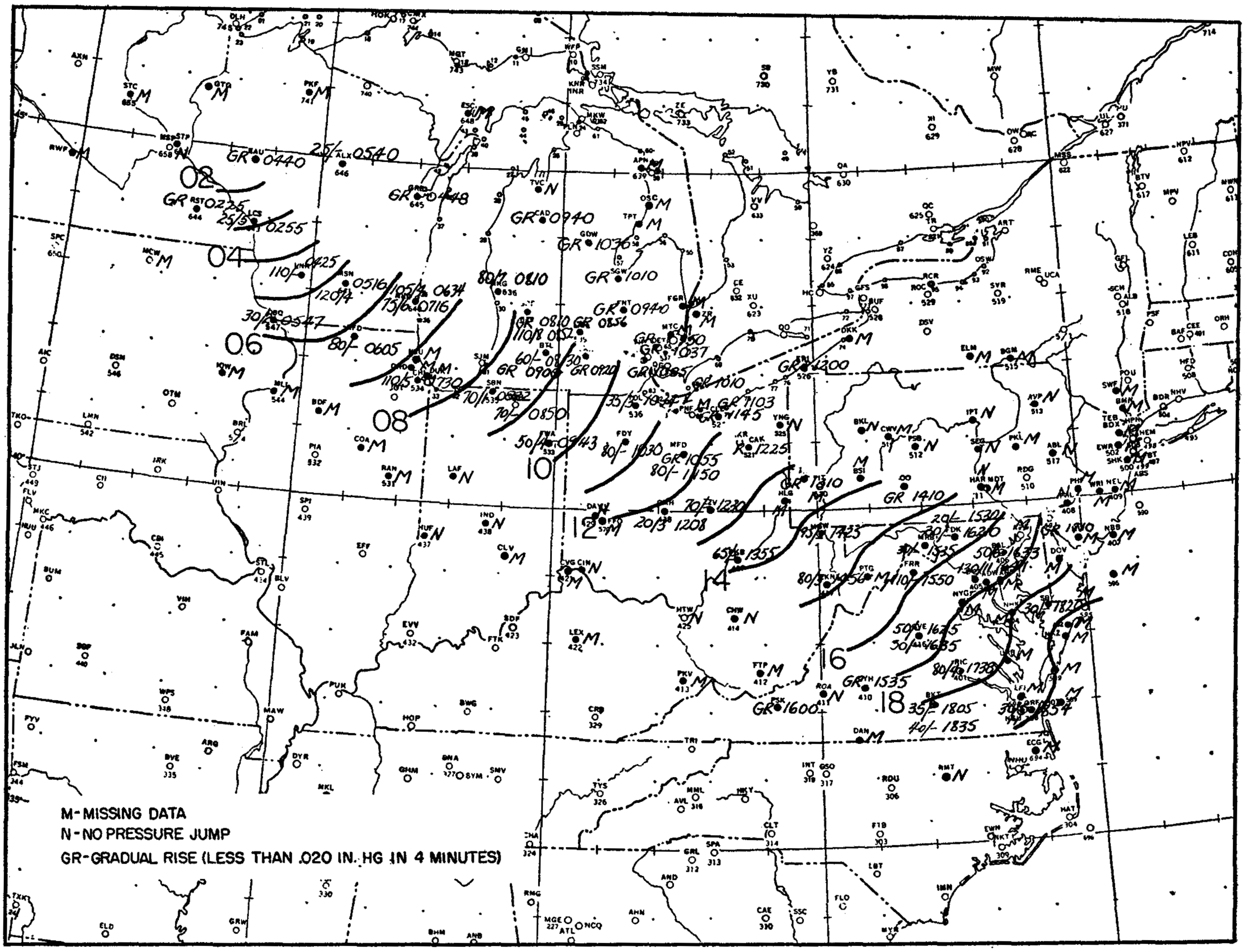

FIGURE 3.—Isochrone analysis of pressure jump line, June 26, 1954. Basic data taken from microbarograms are indicated. To left of station circle is given the ratio of the total pressure rise (in 0.001 in. Hg) to the duration of the rise (in minutes). Dash for duration of rise means reading was from a 4-day trace. To the right of the station circle is the time of beginning of the pressure jump (EST).

Another pressure perturbation, which first made its appearance at Milwaukee, Wis., three-fourths of an hour after the first pressure jump at that station, was identified as a separate system which can be followed as far east as Lansing, Mich., with certainty. This latter perturbation in the Muskegon-Grand Rapids area is not considered here. However, there is a possibility that this line joined the line that originated in western Wisconsin, although data are insufficient to establish this as a fact. The bend that appears in the isochrones in northern Ohio suggests the possibility of two pressure jump lines joining.

Figure 4 illustrates microbarograph traces with significant pressure jumps for stations in the path of the pressure jump line. The horizontal scale is for time. The station call letters are entered beside each trace. The short traces are from 4-day microbarograph sheets, and the other traces are from 12-hour sheets. The time continuity from station to station and the similarity of the pressure rises may be noted, e. g., the steady trace just prior to the sharp rise, the single sharp rise in most cases, and the duration of the higher pressure.

The distance traversed by the pressure jump line from La Crosse, Wis., to the Virginia-Maryland coast was approximately 800 miles in a period of 17 hours, giving an average speed of approximately 47 m. p. h. This distance far exceeds the mean path length of 151–175 miles in the Severe Local Storms Network of the Midwest [1]. The line at the beginning was 60 miles in width (distance between ends of isochrones) and grew to 200 miles in width by the time it passed Washington, D. C., but during most of its history it was approximately 120 miles in width.

SEVERE STORMS

A line of thunderstorms moved with the pressure jump line as it travelled southeastward. The chart in figure 5 illustrates the weather that occurred along the pressure jump line. A broad area was marked off on each side of the path of the pressure perturbation and was divided into zones with time intervals of 6 hours centered on and roughly parallel to the middle isochrone of each zone, with one exception. The exception is the first zone (2300–0500 EST) which is to the west of the first isochrone. The zones were defined to delineate areas of severe local storms and thunderstorms and areas in which these did not occur. Locations of thunderstorms, with or without showers, and severe local storms were obtained from hourly weather sequences and synoptic observations, with the exception of three places. These places were Cumberland and Baltimore, Md., and Washington, D. C. For Cumberland, newspaper clippings were the only source of information. A firsthand description of the storm in Baltimore supplemented the report from the hourly sequences, and in Washington, newspaper reports supplemented the hourly weather report and records at the Central Office.

The legend in figure 5 gives the special set of definitions used to classify the storms reported. The storms were plotted in the appropriate zone if they occurred within the 6-hour interval specified for that zone. Stations for which data were missing were marked "M" and stations at which storms did not occur were marked "N." It will be noted that with but one exception, all known storms within the time interval fell within the path of the pressure jump line. The exception was the thunderstorm at Atlantic City, N. J.

Weather became violent along the pressure jump line shortly after it developed in the Rochester-La Crosse area. At Madison, hail was reported, and at Milwaukee, heavy rain fell. As the line moved across Columbus, Ohio, strong winds with gusts to 52 m. p. h. were reported. Cumberland, Md., which was in the path of the pressure jump line, had a violent wind storm, accompanied by rain and lightning. Descriptions of the storm, such as "near twister," give reason to consider the storm as a possible tornado, perhaps not quite touching the ground.

Violent weather continued to accompany the pressure jump line as it moved southeastward. A micro-network of three accelerated microbarographs in the metropolitan area of Washington, D. C., established by the Severe Local Storms Research Unit gave a detailed picture of the pressure jump line as it passed the city. All three instruments of the network and the instrument at the National Airport had pressure rises of .090 in. Hg or more. At the Central Office, where one of the accelerated microbarographs of the network is located, a record of events was made by other instruments along with the microbarograph. Figure 6 illustrates the sudden changes recorded by the accelerated microbarograph, triple register (precipitation and wind speed and direction), and hygrothermograph. The pressure rose .130 in. Hg (4.4 mb.) in 11 minutes, and in the same length of time the temperature dropped from 94° F. to 72° F., a change of 22°. Two hours before the storm, the temperature had been 99° F. At the time the temperature dropped sharply, the relative humidity rose from 35 percent to 90 percent. Prior to the pressure jump, the wind was southwest at 10 m. p. h. With a slight rise in pressure a few minutes before the jump, the

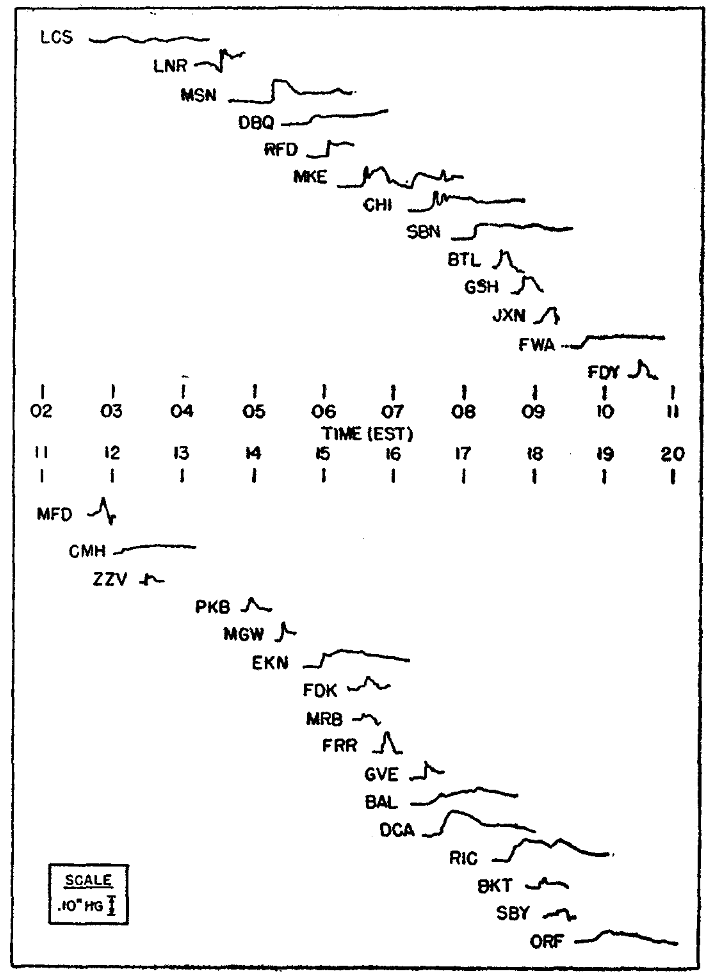

Figure 4.—Microbarograph traces with significant pressure jumps along path of pressure jump line. Short traces are from 4-day charts. Long traces are from 12-hour charts to which time scale applies. Stations are:

LCS—La Crosse, Wis.
LNR—Lone Rock, Wis.
MSN—Madison, Wis.
DBQ—Dubuque, Iowa.
RFD—Rockford, Ill.
MKE—Milwaukee, Wis.
CHI—Chicago, Ill.
SBN—South Bend, Ind.
BTL—Battle Creek, Mich.
GSH—Goshen, Ind.
JXN—Jackson, Mich.
FWA—Fort Wayne, Ind.
FDY—Findlay, Ohio.
MFD—Mansfield, Ohio.
CMH—Columbus, Ohio.
ZZV—Zanesville, Ohio.
PKB—Parkersburg, W. Va.
MGW—Morgantown, W. Va.
EKN—Elkins, W. Va.
FDK—Frederick, Md.
MRB—Martinsburg, W. Va.
FRR—Front Royal, Va.
GVE—Gordonsville, Va.
BAL—Baltimore, Md.
DCA—Washington, D. C.
RIC—Richmond, Va.
BKT—Blackstone, Va.
SBY—Salisbury, Md.
ORF—Norfolk, Va.

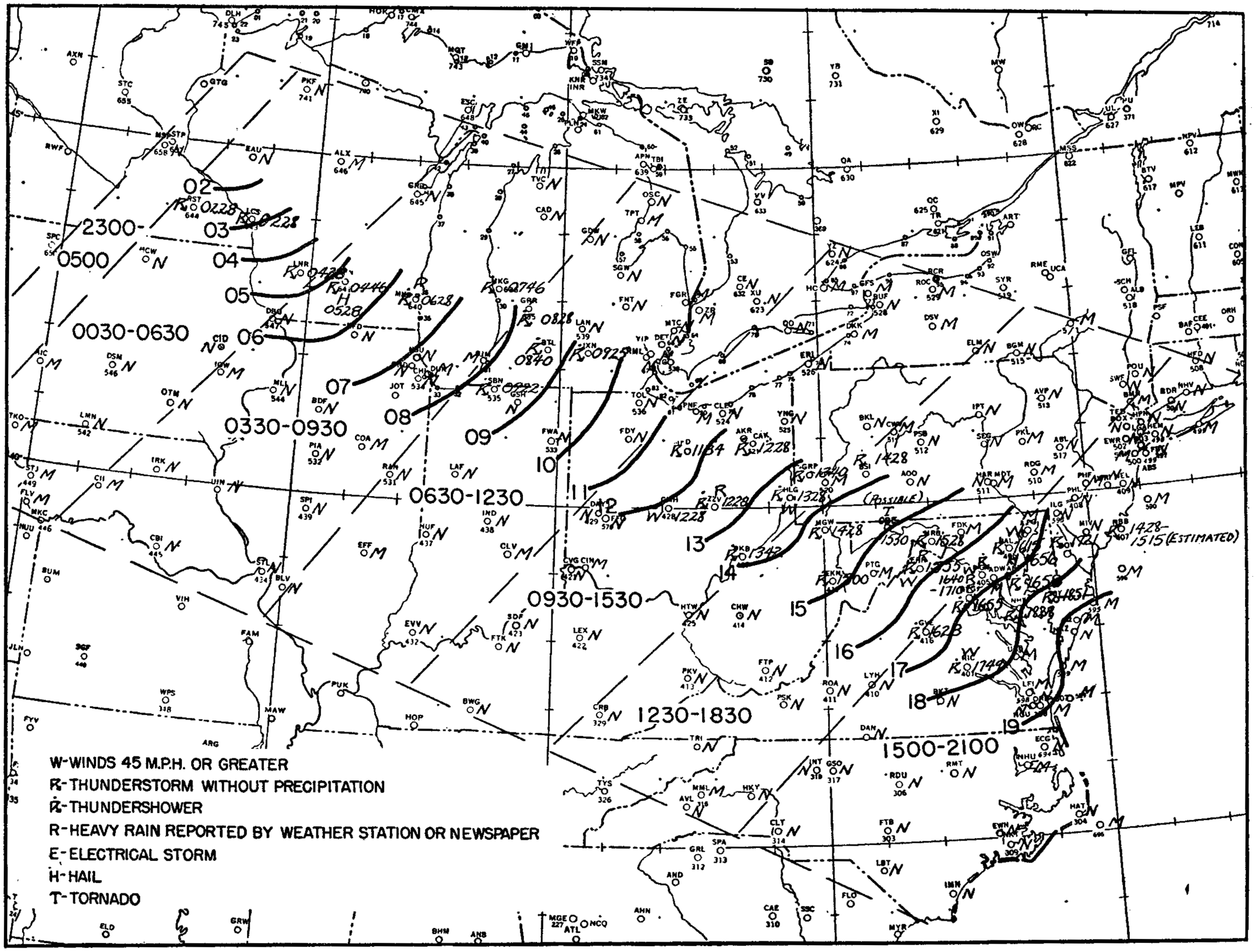

FIGURE 5.—Severe local storms along pressure jump line. All times EST.

wind shifted to west at 10 m. p. h. and then to northwest with the large rise. Within a minute after the beginning of the jump, the wind was northwest at 50 m. p. h. At the National Airport, where the pressure jump began at 1643 EST, precipitation was reported as beginning at 1635. At the Central Office, heavy precipitation began about 10 minutes after the onset of the pressure jump. In the following 10-minute period, 0.51 inch of rain fell. Four minutes later, the total amounted to 0.60 inch.

In the metropolitan area of Washington, D. C., strong winds, clocked at a maximum of 66 m. p. h. at the Weather Bureau at National Airport, did considerable damage. Trees were blown down, blocking roads in nearby Virginia. At least one house was unroofed, and power lines at several points were blown down. The heavy rain caused a small flash flood in one part of the city. In nearby Maryland, several houses were reported struck by lightning.

In Baltimore, where the squall line arrived a few minutes earlier than in Washington, large hailstones fell in the northeastern section of the city, some described as being as large as baseballs.

TEMPERATURE AND PRECIPITATION DISTRIBUTION

Maximum temperatures for June 26 along the path swept by the pressure jump line and surrounding areas were plotted (see fig. 7). The temperature pattern in the western part of the area has little meaning in relation to the pressure jump line, since the line moved through during the morning. However, east of the Appalachian Mountains it may be noted that the largest pressure jumps occurred where the maximum temperatures were highest. Washington, D. C., and Front Royal, Va., both had maximum temperatures of 100° F. Washington

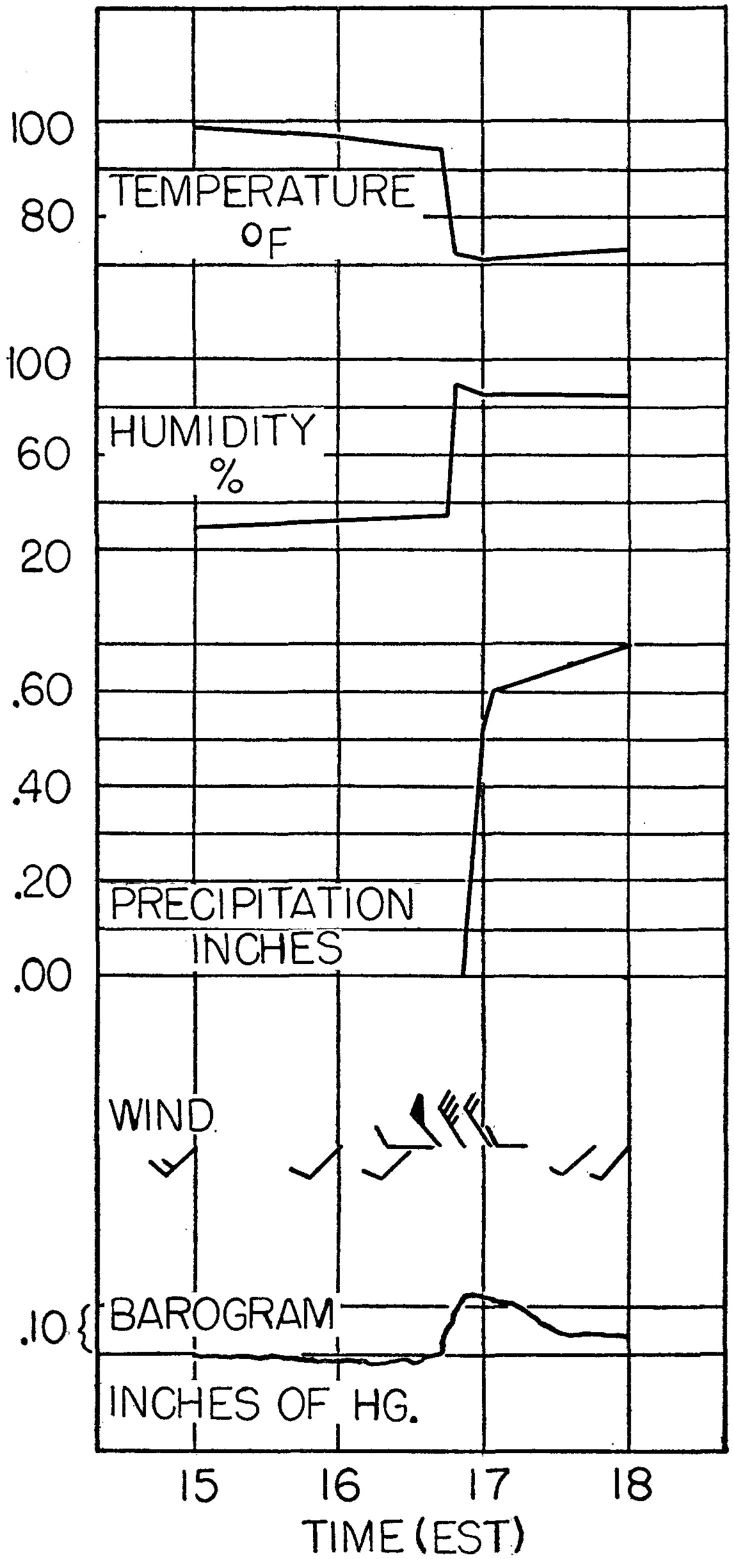

FIGURE 6.—Records from hygrothermograph, triple register, and accelerated microbarograph, Weather Bureau Central Office, Washington, D. C., June 26, 1954.

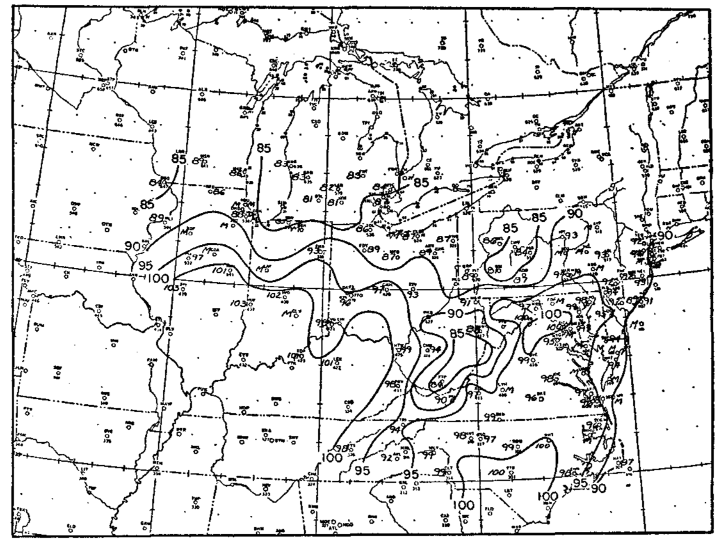

FIGURE 7.—Isotherms of maximum surface temperatures (° F.) along path of pressure jump line and surrounding areas. M=data missing.

had the highest recorded pressure jump, and Front Royal had one of the largest in the area traversed by the system.

Precipitation amounts were entered on another chart (fig. 8) for the area of pressure jumps. The same zones and time intervals were used for this chart as for figure 5. Precipitation data, obtained from hourly weather sequences and synoptic observations, are the amounts for the 6 hours ending at the time of the synoptic observation. However, in most cases these figures represent the precipitation that fell along the pressure jump line, since precipitation was not widespread at any time during the 6-hour interval except coincident with the pressure perturbation. Two areas of maximum rainfall existed, one centered around Milwaukee, Wis., and the other at Washington, D. C. A secondary maximum might be said to exist near Zanesville, Ohio. The two maxima lie along the northern part of the isochrones and the secondary maximum lies at the southern end of the isochrones. There is no ready explanation for the lack of or small amount of precipitation in the region between Chicago and Fort Wayne, Ind. Diurnal effects may have minimized the influence of the pressure jumps on the atmosphere. Maximum rainfall did not occur at all points of large pressure rises, but examination of figures 3 and 8 will show that the greatest amounts of rainfall coincided with areas of maximum pressure rises.

It is of significance that most of the precipitation fell within the boundaries of the path traversed by the pressure jump line. The traces of rainfall that fell in southern Michigan outside the path may be attributed to the second pressure jump line that was first detected at Milwaukee. The trace of precipitation at Cadillac was drizzle. At Atlantic City, N. J., rain occurred approximately four hours before the pressure jump line was nearest the station.

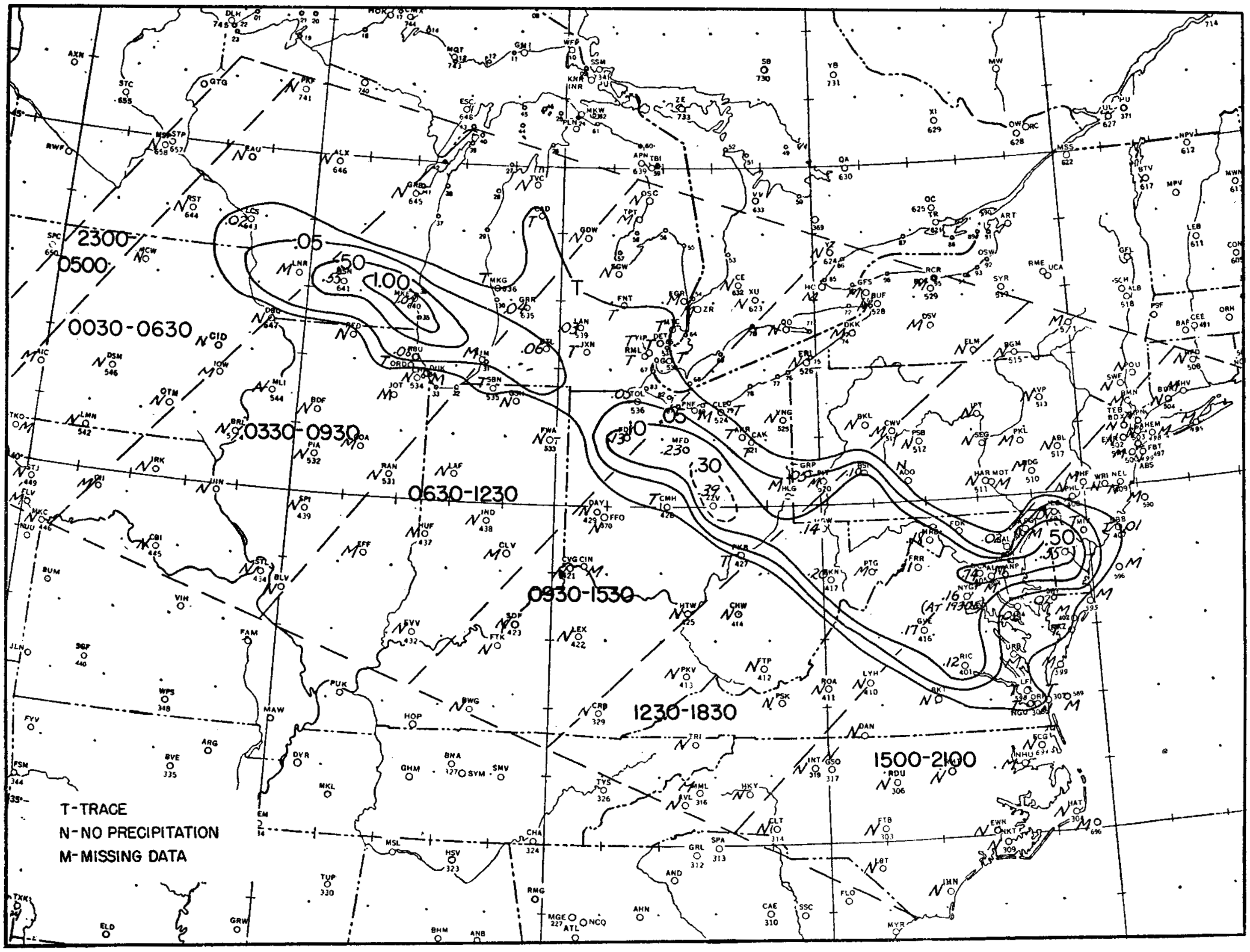

FIGURE 8.—Precipitation area along path of pressure jump line. Precipitation in inches. Time intervals in EST.

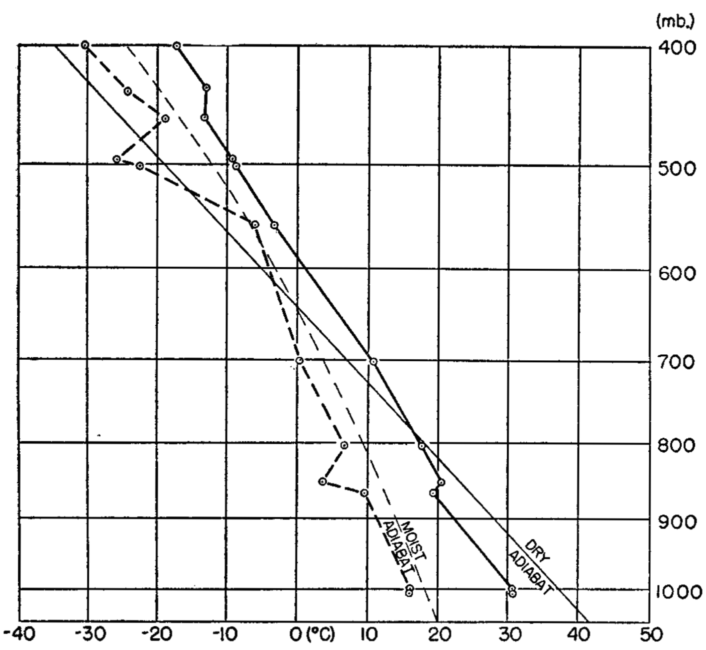

FIGURE 9.—Upper air sounding for Washington, D. C., 1030 EST, June 26, 1954. The temperature curve is represented by solid line; dew point curve by dashed line.

UPPER AIR DATA

Investigation of the radiosonde observations at 0300 GMT for St. Cloud, Minn., and Green Bay, Wis., reveals inversions at 850 mb. and 790 mb., respectively. Both stations were in the cold air at the time, and the inversions may be assumed to be the frontal surface at those stations. Representative of stations in the warm air are Pittsburgh, Pa., Washington, D. C., and Norfolk, Va. The 1500 GMT soundings for these stations show an inversion near the 850-mb. level (see fig. 9, Washington sounding). Near 500 mb. a stable layer existed at all radiosonde stations which were checked. From the data it becomes evident that the 850-mb. level and the 500-mb. level were the only surfaces along which an atmospheric gravity wave could have been propagated for any great distance [2]. One possible interpretation is that a gravity wave formed

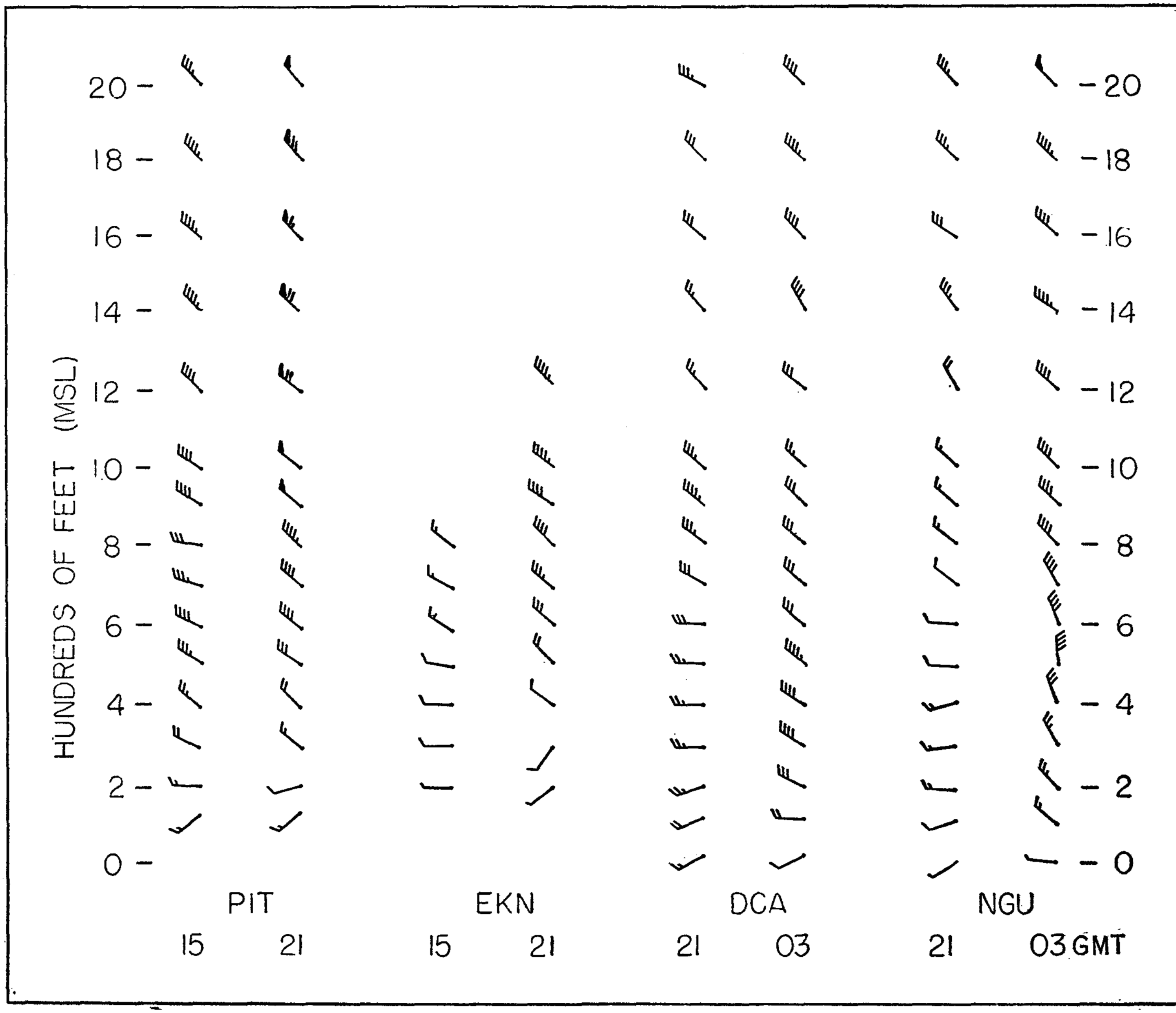

FIGURE 10.—Winds aloft before and after passage of the pressure jump line at Pittsburgh, Pa. (PIT), Elkins, W. Va. (EKN), Washington, D. C. (DCA), and Norfolk, Va. (NGU) (Navy Station).

near La Crosse and was propagated along the frontal surface or inversion (850 mb.). Near Chicago it may be assumed the perturbation somehow started passing into the warm air and was propagated along the inversion surface near 850 mb. The other possibility is that a gravity wave formed near La Crosse and was propagated along the stable layer near 500 mb. Although previous investigations concerning gravity waves in the atmosphere favor the idea of propagation at lower levels, the possibility of a gravity wave at 500 mb. should not be overlooked, especially since the inversion near 850 mb. at Washington had disappeared by 2100 GMT due to surface heating. It is not known whether or not the inversion at other stations had disappeared since the Washington sounding for 2100 GMT is the only one available in the area. Some remnant of the inversion near the 850-mb. level may have existed over much of the area from the Appalachians eastward during the afternoon, although surface temperatures at many points indicated an almost dry adiabatic lapse rate to 850 mb. and above. Examination of the winds aloft failed to reveal any particular level of wind shear which would indicate a discontinuity in the atmosphere along which a gravity wave could be propagated.

From figure 10 it can be seen that winds at most of the levels increased after the pressure jump line passed a station. However, winds above 10,000 feet showed a tendency to increase more than those below. The pressure jump line was located beneath the narrow band of jet winds at upper levels.

CONCLUSION AND SUMMARY

The pressure jump line which originated in western Wisconsin behind the cold front was accompanied by a line of thunderstorms that deteriorated as the line moved through the front near Chicago. As the line moved into Ohio, thunderstorms again developed along it. Reasonable continuity indicates that the pressure jump line moved across the Appalachians and to the Atlantic Coast, accompanied by thunderstorms which were rather severe in the Baltimore and Washington areas. The atmospheric gravity wave producing the pressure jump perturbation is believed to have been propagated along either the 850-mb. or the 500-mb. level.

ACKNOWLEDGMENTS

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